

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Vishnu G. Kamat et al.

Assignee: Synopsys, Inc.

Title: CORRECTING 3D EFFECTS IN PHASE SHIFTING MASKS
USING SUB-RESOLUTION FEATURES

Serial No.: 10/774,342 File Date: February 5, 2004

Examiner: Stacy Whitmore Art Unit: 2825

Docket No.: NTI-0848

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Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

AMENDMENT IN RESPONSE TO THE FIRST OFFICE ACTION

Initial Comments

Claims 1-25 are pending in the present application. Claim 25 is rejected under 35 U.S.C. 102(e) as being anticipated by U.S. Patent Application Publication 2004/0096752 (Liebmann) or by U.S. Patent Application Publication 2003/0068564 (Liu). Claims 1-11, 13-19, and 21-24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Liu in view of U.S. Patent Application Publication 2004/0191650 (Pierrat). Claims 12 and 20 are objected to as being dependent on rejected base claims, but would be allowable if rewritten in independent form to include all of the limitations of the base claims.

Claim 25 is cancelled, thereby rendering the rejection of that claim moot.

AMENDMENTS TO THE CLAIMS

1. (Original) A method of designing an alternating phase shifting mask (PSM), the method comprising:

converting a layout to an alternating PSM design including 0 degree phase shifters and 180 degree phase shifters; and incorporating blockers in the alternating PSM design, wherein a blocker is formed in a 0 degree phase shifter to minimize an intensity imbalance with its corresponding 180 degree phase shifter.

2. (Original) The method of Claim 1, wherein incorporating blockers includes growing a length of the blocker.

3. (Original) The method of Claim 1, wherein incorporating blockers includes forming a plurality of blockers in the 0 degree phase shifter.

4. (Original) The method of Claim 1, wherein if a 180 degree phase shifter includes a sub-resolution feature, then sizing the blocker in the 0 degree phase shifter to be larger than the sub-resolution feature.

5. (Original) The method of Claim 1, wherein incorporating blockers creates a substantially uniform intensity imbalance error on the alternating PSM.

6. (Original) The method of Claim 1, further including performing optical proximity correction (OPC) on the alternating PSM design.

7. (Original) The method of Claim 6, wherein performing OPC is done after incorporating blockers in the alternating PSM design.

8. (Original) The method of Claim 6, wherein performing OPC is done before incorporating blockers in the alternating PSM design.

9. (Original) A method of generating an alternating phase shifting mask (PSM) design including 0 degree phase shifters and 180 degree phase shifters, the method comprising:

minimizing an intensity imbalance between a 0 degree phase shifter and a 180 degree phase shifter corresponding to the 0 degree phase shifter by incorporating a first sub-resolution feature in the 0 degree phase shifter.

10. (Original) The method of Claim 9, wherein incorporating the first sub-resolution feature includes growing a single dimension of the first sub-resolution feature.

11. (Original) The method of Claim 9, wherein incorporating the first sub-resolution feature includes forming a plurality of sub-resolution features in the 0 degree phase shifter.

12. (Original) The method of Claim 9, wherein if the 180 degree phase shifter includes a second sub-resolution feature, then sizing the first sub-resolution feature to be larger than the second sub-resolution feature.

13. (Original) The method of Claim 9, wherein incorporating the first sub-resolution feature for each 0 degree phase shifter and 180 degree phase shifter of the alternating PSM creates a

substantially uniform intensity imbalance error on the alternating PSM.

14. (Original) The method of Claim 9, further including performing optical proximity correction (OPC) on the alternating PSM design.

15. (Original) The method of Claim 14, wherein performing OPC is done after incorporating minimizing intensity imbalance.

16. (Original) The method of Claim 14, wherein performing OPC is done before incorporating minimizing intensity imbalance.

17. (Original) An alternating phase shifting mask (PSM) comprising:

a 180 degree phase shifter;

a 0 degree phase shifter corresponding to the 180 degree phase shifter; and

at least one sub-resolution feature formed in the 0 degree phase shifter to minimize an intensity imbalance with the 180 degree phase shifter.

18. (Original) The alternating PSM of Claim 17, further including an undercut in the 180 degree phase shifter.

19. (Original) The alternating PSM of Claim 17, further including a bias in the 180 degree phase shifter.

20. (Original) The alternating PSM of Claim 17, further including a sub-resolution feature formed in the 180 degree phase shifter, wherein the sub-resolution feature formed in the

0 degree phase shifter is larger than the sub-resolution feature formed in the 180 degree phase shifter.

21. (Original) A computer-implemented system for generating an alternating phase shifting mask (PSM) design, the alternating PSM design including 0 degree phase shifters and 180 degree phase shifters, the system comprising:

an input interface for receiving a layout;
means for converting the layout to the alternating PSM design, wherein the alternating PSM design includes a blocker formed in a 0 degree phase shifter to minimize an intensity imbalance with a corresponding 180 degree phase shifter; and
an output interface for outputting the alternating PSM design.

22. (Original) The computer-implemented system of Claim 21, wherein the means for converting includes software code for increasing a dimension of the blocker to improve the intensity imbalance.

23. (Original) The computer-implemented system of Claim 21, wherein the means for converting includes software code for creating a uniform intensity imbalance error on the alternating PSM using a plurality of blockers.

24. (Original) The computer-implemented system of Claim 21, wherein the means for converting includes software code for performing optical proximity correction (OPC) on the alternating PSM design.

25. Cancelled.

REMARKS

This Amendment is filed in response to the Office Action dated February 13, 2006, which has a shortened statutory period set to expire May 13, 2006.

Disqualification Of U.S. Patent Application Publication

2003/0068564 (Liu) and U.S. Patent Application Publication

2004/0191650 (Pierrat) As Prior Art

U.S. Patent Application Publication 2003/0068564 (Liu) and U.S. Patent Application Publication 2004/0191650 (Pierrat) as well as the present application were assigned to the same entity, Numerical Technologies, Inc. More specifically, all three patent applications (i.e. U.S. Patent Application 09/974,507 (Liu), U.S. Patent Application 10/818,727 (Pierrat), and U.S. Patent Application 10/774,342 (Kamat) were jointly owned by Numerical Technologies, Inc. at the time the invention of U.S. Patent Application 10/774,342 (Kamat) was made.

As a result, in accordance with MPEP 706.02(1)(1) and 706.02(2), these patent application publications can be disqualified as prior art under 35 U.S.C. 103(c)(1). Therefore, Applicants respectfully request that U.S. Patent Application Publication 2003/0068564 (Liu) and U.S. Patent Application Publication 2004/0191650 (Pierrat) be disqualified as prior art.

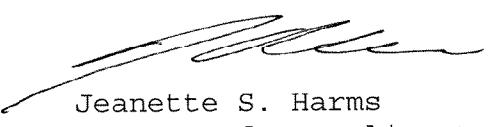
In light of the disqualified art, only U.S. Patent Application Publication 2004/0096752 (Liebmann) remains as cited prior art. Liebmann is cited only with respect to Claim 25, which is cancelled. Therefore, Applicants request reconsideration and withdrawal of the rejection of Claims 1-11, 13-19, and 21-24.

Claims 12 and 20 depend from Claims 9 and 17, respectively. Because Applicants believe Claims 9 and 17 to be patentable, Applicants have not amended Claims 12 and 20 herein.

CONCLUSION

Claims 1-24 are pending in the present application.
Allowance of these claims is respectfully requested.
If there are any questions, please telephone the
undersigned at 408-451-5907 to expedite prosecution of this
case.

Respectfully submitted,


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